THE ULTIMO POWER HOUSE
THE HISTORY AND TECHNOLOGY OF THE
ULTIMO POWER HOUSE SYDNEY

A report for the Government Architects Branch,
Public Works Department of New South Wales.

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THE ULTIMO POWER HOUSE SITE (FACING NORTH)

The block is bounded by Harris Street on the west, William Henry Street on the north, Macarthur Street on the south, and the Darling Harbour Goods Yard on the east.

The sites fronting onto Harris Street, from north to south are:

The Post Office, which was built in 1901.

The two adjoining buildings were owned by Carmichael Agencies. The building nearest the Post Office, no. 496, was known as the Dalton Building and was built by Herman Haege Pty. Ltd. in 1960. The building next to the Dalton was built by the previous owners, the Sydney Glass Co. Pty. Ltd.

The Ampol Service Station was constructed in the 1950's.

The vacant block is the Harris Street frontage owned by the Railways and was bought from the Sydney Glass Co.

The building on the corner of Harris and Macarthur Streets, known as the Manassen Building, was owned by Manassen Investments. Manassen bought the building from Maize Products Pty. Ltd. who built it in 1938.

The central row of buildings and the eastern most row, are the Power House proper.

Those buildings in the central row are:

The office building, with the water tanks on the roof.
The engine room, with the vent standards.
The turbine hall, which has the prominent roof monitor.
The switch house, with the flat roof.

Between the office building and the Dalton building is the Tramway Instruction Room which was built in c.1914.

The eastern row of buildings from north to south are:

The boiler house, with its demolished chimneys, roof monitors and ventilation scoops. South of the boiler house is the large concrete coal store.
ACKNOWLEDGEMENTS

The report by Lionel Glendenning and Warwick Upton of the Department of Public Works, NSW, provided a great deal of information as well as listing sources for further research. Warwick Upton also made available all material collected during his original work. Mike Jenkins, Anne Watt and Julie Carras, from the same Department, were always ready to help and discuss the site.

Bob Irving inspected the buildings and supplied the information for the architectural description.

Rob Morris oversaw the demolition of the turbine hall and boiler house and was responsible for making the collection of artifacts.

Sybil Jack, Meredith Walker, Helen Temple and Mike Pearson inspected the buildings and provided new insights.

Daryl Mead and Margaret Simpson both worked on the project with their usual flair and conscientiousness, until called by the Museum for more permanent duties.

The management and men of R.J. Brady Demolitions cooperated with the team at all times.

Mr. E. Crawford, Mr. T. Williams, and Mr. A. Howard, all former Superintendents of Ultimo Power House, supplied information on the electrical and managerial side of the works.

Mr. H. Hartcher and Mr. L. Berry, both former Power House workers, gave information on working conditions and operations of the boiler house.

John Ross and Paul Fennell worked tirelessly to record the buildings photographically before demolition commenced, and to photograph and reproduce prints lent to the team.

Others who helped included Estelle Laser, Linda Young, June Odlum, Paula Koussa, Len Cubis, Geoffrey Volk, Patricia Chisholm and Fiona Bush.
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NOMENCLATURE

The buildings that make up the Ultimo Power House have been known by more than one name by officials of government departments, workers, and more recently by those interested in the history of the Power House. In some cases this lack of standardisation has led to misunderstandings.

In the following discussion the nomenclature used in this report will be given first, followed by the various alternatives used in other places.

The Office Building has been known as the administrative building, the amenities block and the north annexe as the function of the building changed.

The Pump Room was originally a part of the Old Boiler House. The old boiler house consisted of the pump room and the boiler hall, although the boiler hall, which was the principal part of the building, was after referred to as the boiler house. The old boiler hall was incorporated in the new boiler house.

The New Boiler House -or Boiler House contained a new pump room although this new pump room was never regarded as a separate entity.

The Engine Room has been called the generating room, the engine hall, the old engine room and the substation.

The Turbine Hall was first known as the engine room extension as it first housed reciprocating engines rather than turbines. The common acceptance of the name turbine hall did not occur until about 1910.

The Switch House was never upgraded or extended and has always kept the same name.
BRIEF
TECHNOLOGICAL AND ARCHAEOLOGICAL INVESTIGATION
OF THE ULTIMO POWER HOUSE, ULTIMO

1. Nature and Purpose of the Task

The consultant will be required to carry out, co-ordinate and be responsible for the research and documentation of the technological and archaeological significance of the Power House Ultimo and its site, to identify and record features of particular archaeological sensitivity and to provide archaeological and technological advice concerning the site. All archaeological aspects of this brief shall be undertaken by a qualified archaeologist engaged by the consultant.

2. Location

The subject of this investigation is the complex known as the Power House Ultimo and the features, structures and works which the consultant is required to investigate are bounded by William Henry Street, Harris Street, Macarthur Street and the Darling Harbour railway line.

3. The Work

The consultant will be required to:

(a) prepare a detailed descriptive and analytical history of the site, based on documentary, photographic, architectural, archaeological, oral and other forms of evidence, and including comments on unsuccessful areas of enquiry;

(b) carry out an archaeological and architectural survey to locate, record, interpret and evaluate evidence relating to the history and function of the Ultimo Power House. This should include:

(i) documentation of the form of, changes to and functions of structures and works on the site from initial construction to present day;

(ii) documentation of foundations, works, features, and structures no longer standing and any changes in the curtilage of the site;

(iii) documentation of building materials and the selection and/or identification of samples for future reference;
(iv) analysis and recording of building techniques used in all structures within the complex;

(c) identify, discuss and where possible record, the various industrial processes carried out at the site. This should include:

(i) investigation and identification of equipment used, surviving physical evidence of such equipment and its use, processes employed, materials flow and energy flow;

(ii) documentation of the remains of all machines, apparatus and structures on site and an outline of the chronology of technological change where possible;

(d) compile, so far as possible, an archive of extant documentary, photographic and oral evidence, plans and drawings and, where appropriate, artefacts etc. relating to the Power House;

(e) prepare a statement of the archaeological significance of the complex of buildings, structures, works and features at the site and prepare a draft Archaeological Zoning Plan in accordance with the guidelines of the Heritage Council of N.S.W.;

(f) prepare and collect plans, photographs and other graphic material to illustrate the work;

(g) compile a photographic archive of all buildings, structures, machines etc., including a set of black and white contact prints and original negatives and colour slides (catalogued) which document the significant features of the fabric of all structures and works;

(h) liaise as required with the Museum, the Project Architect and Builder and provide consultant advice on any aspects of the works programme to the Public Works Department as required by the Project Director;

(i) prepare recommendations for further technological or archaeological investigation if this is considered necessary;

(j) in consultation with the Project Director or his nominee advise on possible historical and technological display themes relating to the Power House, including how the building itself can be used as an exhibit.
(assistance of the Museum in providing professional quality photographs for possible display use may be available);

(k) attend progress meetings with the project liaison officer or other consultants as required by the Project Director;

(l) prepare reports in the required form, as recommended by the Archaeological Advisory Panel of the Heritage Council of N.S.W.;

(m) be responsible for amending, proof reading and correcting all parts of the reports as required by the Project Director.

4. The Reports

The consultant will be required to prepare reports (which incorporate the results of the work outlined above) as follows:-

**Progress Report**

This report shall set out the progress of the consultant's research, investigations, identifications, preparations, documentations, consultations, liaisons, discussions, interpretations, considerations and analysis undertaken in relation to the work. It shall also include a section containing Recommendations on the future treatment of features of outstanding technological or historical significance, and an interim Archaeological Zoning Plan.

**Draft Final Report and Final Report**

These reports shall include:-

- (a) a statement of the aims of the study;
- (b) a copy of the brief;
- (c) a detailed history of the site;
- (d) a statement of the archaeological significance of the site, buildings, works and relics identified within it;
- (e) detailed information on physical evidence of the history and function of the Ultimo Power House;
- (f) chronologies of all structures, equipment and processes identified in 3 (b) above and diagrammatic illustrations where possible;
(g) analysis of all production processes employed in accordance with 3 (c) of this Brief;

(h) a draft Archaeological Zoning Plan for the site;

(i) discussion of potential threats or damage to all significant or sensitive areas and recommended action to conserve or investigate these;

(j) graphic and photographic material as necessary to illustrate the report;

(k) a photographic archive of all buildings, structures, machines in accordance with 3 (g) of this Brief;

(l) recommendations for more detailed technological and/or archaeological investigation where these are considered relevant to the conservation project or any other aspect of this research;

(m) a record of any significant features or relics revealed in the course of building works in accordance with paragraph 5 of this Brief.

The final report is to be typed on A4 Bond paper in accordance with standards laid down by the Heritage Council of N.S.W. and an unbound original and six (6) bound copies are to be submitted to the Project Director on the required date. It should be presented in a form suitable for publication with minimal editorial changes.

5. Availability for Additional Research

The consultant is required to provide archaeological supervision as directed by the Project Director where disturbance of archaeological fabric is necessitated by building or other works until January 22nd, 1983. The consultant is also required to provide advice on any aspect of the works programme to the Department of Public Works upon receipt of the Project Director's instructions to do so. Documentation relating to these matters should be included as a separate section of the final report. From January 22nd, 1983 the PWD will be required to provide archaeological supervision of the site.

6. Methodology

(i) the consultant should liaise closely with the Project Director or his nominee. The Project Director will be Mr. Desmond Kennard, Deputy Director, Maas.;

(ii) the investigation will include archival research and close liaison with the Public Works Department
or their representatives, the Project Architect and Supervising Builder;

(iii) as the report may be published in some form by the Department, recommendations in the report should be appended in a separate section. All photographs, drawings and plans are to be in a form suitable for reproduction in A4 size and in accordance with standard archaeological practice;

(iv) as the report will be used by professional people without archaeological or technological training the report should be devoid of jargon and directed towards such persons. The recommendations should be clear and concise and the supportive material clearly presented.

7. Time

The consultant shall be required to submit the following reports to the satisfaction of the Project Director:

(i) a progress report by Friday, 24th December 1982;
(ii) a draft final report by 26th March, 1983; and
(iii) the final revised report, within four weeks of receiving the Project Director's written comments on the draft.

Original prepared by Don Godden and revised by John Wade.

Endorsed by

Submitted to the Director for formal approval

16 November 1982
INTRODUCTION

This report is in two parts. Volume 1 contains the introduction, the original brief, statement of cultural significance, recommendations, architectural description, history of construction of the buildings and installation of machines, and a description of the Power House as a workplace before the First World War.

The second part is the appendix, which contains diagrams and tables and the archaeological record of the demolition work carried out on the site. This demolition is not yet complete. The second volume will be submitted immediately the demolition, and excavation of the site and the water conduits are concluded. The appendix also contains the photographic catalogue and catalogue of artifacts collected on the site.

It is worth noting that the archaeological finds both within the Power House and on the site between the building and Harris Street could best be described as disappointing.

The emphasis of the first part of the report is on the Power House as a complex of buildings, the history of technology of steam electric generation within the Power House, and the relation between that technology and the growth and configuration of the buildings.

The appendix contains much material on which the report proper was based and is meant to act as a guide for future research.

For that reason the appendix also contains a list of people who possess information or material on the Power House and a list of the whereabouts of photographic collections, plans and maps concerning the Power House.
CULTURAL SIGNIFICANCE

INVESTIGATING CULTURAL SIGNIFICANCE

The statement of cultural significance is the basis by which decisions about the conservation policy for the building are made. This policy is formed after the consideration of all the issues and factors involved in its future, namely, the needs and resources of the client, and the requirements of building, town resources of the client, and the requirements of building, town planning and other regulations. Ideally, plans for the future of an item of heritage significance should not be formulated before a statement of significance is proposed. In the instance of the Ultimo Power House, many of the decisions about the future of the building have already been made, some consideration has been given to internal arrangements for museum use. The time needed to consider matters in the ideal circumstances is not available.

This report is therefore written in a pragmatic vein. The building has been researched and examined in detail and its significance identified. In a building of this scale and complexity it was difficult to predict the time needed for research and investigation and there are several areas which need further investigation. These areas are outlined in the appendix under the heading Additional Research. Further examination of the site may increase our knowledge of certain processes or changes but is unlikely to reveal any further aspects of significance.

The statement of significance is necessarily general. The one below does not follow rigidly the guidelines as set out by ICOMOS but is adapted from it.

The Recommendations derive from the statement of significance combined with an assessment of the present circumstances and future of the building (as known to the consultants).

The Recommendations are annotated, it is hoped that the annotation will serve to clarify the reasons behind certain decisions.

An archaeological zoning plan, conforming to the guidelines of the N.S.W. Heritage Council, was attempted, but was not feasible because of the complexity of the buildings. Structures or areas within them could not be designated as falling into a particular category, as only part of them belonged in the category. It was evident also that even a single element in a large structure could not be designated with a single category for the same reason.
STATEMENT OF CULTURAL SIGNIFICANCE

1.0 Historical significance

.1 Electricity Generation
  .1.1 The fabric of the Ultimo Power House embodies the spectacular growth of electric power in Sydney and the technological changes that accompanied that growth.
  .1.2 Ultimo is the oldest of the extant power houses in N.S.W.
  .1.3 The Power House housed the most important innovations in steam-electric generation from the late 19th Century to the mid 20th Century.
  .1.4 At the time of the completion of the first expansion phase, Ultimo was the largest and most powerful electricity generating unit in the Southern Hemisphere.

.2 Building construction
  .2.1 The Boiler House and Turbine Room are the earliest buildings in Sydney to have such large unsupported spans.
  .2.2 The gallery floors
     The gallery floors on the north and west walls of the Engine Room were formed on specially rolled corrugated permanent formwork which is one of the few surviving examples in Sydney.

.3 Mechanical Engineering
  .3.1 The overhead travelling cranes when installed in the Engine Room and in the Turbine Hall in the first expansion were the most modern of their type in the world and are now rare.

2.0 Aesthetic Significance

.1 Architectural
  .1.1 The most intact and important group of electricity generating buildings in N.S.W.

.2 Townscape
  .2.1 The Power House is an integral part of the Pyrmont-Ultimo industrial development belt which includes the woolstores and Pyrmont Power Station and is thus part of a wall of buildings which forms the boundary and separates it from the Central Building District. It is one of the most spectacular industrial landscapes in Sydney.
3.0 Social Significance

.1 Social Values

.1.1 The building, and the changes to its fabric, demonstrate changes in social values and attitudes in respect of the Power House workers and their working conditions.

.2 Commuter network

.2.1 The Power House was built to supply electricity for the first major tramway in Australia, and for the conversion of other tramways to electric traction. The tramway network revolutionised commuting in early 20th century Sydney and played a significant part in the growth of suburban Sydney.
RECOMMENDATIONS

1.0 PREAMBLE

The Ultimo Power House is one of the oldest and most important industrial buildings in Sydney. Despite the absence of the machinery, the building in its current condition presents an invaluable opportunity to indicate the scale and nature of late 19th and 20th century industry. In the realm of conservation, opportunities for the retention of industrial structures and apparatus are scarce, hence the need for industrial museums. Although such museums can exhibit much of the technology of industry and machinery, they seldom give much indication of the buildings in which they operated.

As the Museum of Applied Arts and Sciences, the building should be seen as an artifact in its own right and it should be very carefully conserved, displayed and interpreted. Under no circumstances should the Ultimo Power House be seen merely as a shell of a building which is to house the new museum. It is accepted that when a building is to be re-used that a number of alterations must take place to the fabric, but in a building of such cultural significance these changes should be kept to a minimum. The fabric includes, the interior as well as the exterior of the building, and, just as importantly, the machinery, equipment and structures as well as the actual walls, floors and roof of the building proper.

The Power House has undergone a great number of changes to its fabric since construction in 1899. However these changes were strictly in accord with those necessary for the effective steam electric generation for the Sydney tramway system. Now that the building is to be re-used as a museum, it is essential that any changes to the fabric recognise the heritage significance of the building.

Many of the features of the Power House extant in July 1982 have already been removed. Included in the features removed are the massive concrete engine pads on which the 20,000 kW Parson's turbines were mounted, the tiled walkways which surround them, the switchboard gallery on the western wall of the engine room, the bus-bar cabinets in the switch house and the hoppers and columns at the north end of the boiler house.

Two areas have been designated as interpretative areas. These are the engine room which was completed in 1899 and the south end of the Boiler Hall which was completed in 1902 and upgraded several times. These areas should be conserved in their present configuration to indicate to visitors some of the complex internal structures that were built over time in the pursuit of more efficient means of steam electric generation. Only where features are structurally unsound should consideration be given to their removal - and then, only after it has been ascertained that they cannot be economically conserved.
2.0 OFFICE BUILDING

.1 External

.1.1 General

.1.1 The building is almost completely intact externally. Conservation measures should be minimal and may include cleaning of all masonry and preservation or reconstruction of damaged stone, wood and metal.

.1.2 The Roof Area

.1.2.1 The small structure protecting the spiral stair access to the roof should be reconstructed.

.1.2.2 One of the cast iron water tanks on the roof should be retained and be preserved - if this can be done without damaging the roof. The remaining tanks, associated pipes and conduits may be removed.

.1.2.3 The fire resistant terracotta roof should be preserved.

.1.3 The Entrance

.1.3.1 This area should be reconstructed. The handrail should be removed and the original doors reconstructed using documentary evidence.

.1.3.2 The leadlight window should be reconstructed.

.1.3.3 The doors on the loading dock should be reconstructed using documentary evidence.

.2 Internal

.2.1 General

.2.1.1 The present configuration of rooms, entrances and penetrations should be preserved. All skirtings, floor and small tiles and plasterwork should be preserved or reconstructed.

The office was the most elaborate of the original buildings, both internally and externally. Its prime significance lies in its aesthetic and architectural qualities.

Water tanks. These cast iron tanks were manufactured in Newcastle by the N.S.W. Government Railway Permanent Way workshops in 1931 and appear to follow the pattern of the railway water tanks.

The internal configuration represents changes that have taken place as the level of technology increased and as the working conditions improved.
.2.1.2 Basement level
Openings may be cut through the terracotta walls to allow access to the rooms at the western end of the building. The present floor levels should be preserved.

.2.1.3 Ground floor
All toilets, shower cubicle remains and internal office partitions may be removed.

.2.1.4 First floor
The terracotta, wood and glass portions and the internal masonry walls should be removed. The toilets and basins at the western end should be removed.
The spiral staircast to the roof should be reconstructed using both physical and documentary evidence.

3.0 ENGINE ROOM

.1  External

.1.1  General

.1.1.1 This building is intact except for the eastern wall. The facade should be preserved.

.1.2  The roof

.1.2.1 The corrugated iron roofing material should be conserved. The box guttering and downpipes should be reconstructed.

.1.2.2 The zinc louvres on the lantern should be preserved.

.1.2.3 The existing air vents should be preserved and all missing airvents should be reconstructed.

In the realm of steam-electric generation technology, this is the most significant of all the buildings. It was built to house the DC generating equipment and part of its interest is its size relative to the newer Turbine Hall.
The matchboard ceiling should be preserved or reconstructed.

The roof trusses, central lattice columns, the cranes and crane rails and beams should be preserved and beams should be preserved.

The tiled wall should be reconstructed.

The Galleries

Both mezzanine galleries should be preserved or reconstructed.

The remaining section of slate switchboard on the DC gallery should be preserved insitu. At least two concrete cabinets on the western converter gallery should be preserved.

The toilet and washroom beneath the DC gallery (north wall) should be removed and the area reconstructed. The staircase on the west end of the gallery should be reconstructed. The staircase near the eastern end should be reconstructed in its present position.

The Floor and Basement

The floor of the generating room should be reinstated. The holes formerly occupied by the five rotary converters should be suitably infilled to provide a level floor. The engine beds which protrude above the floor may be removed and the surface cement rendered to the level of the floor. The cast iron access grids should be reinstated.
2.3.2 The basement should be cleared of all conduits and all unsubstantial accretions including the wire mesh security fences.

2.3.3 The tunnel located on the axis of the building which runs beneath the basement of the office building and contains the terracotta conduits should be preserved and should be accessible to the public.

2.3.4 The Substation Switchboard

The remaining slate panels on the substation switchboard which was located in the centre of the room should be removed carefully and stored - consideration should be given to relocating them on the DC gallery.

4.0 THE TURBINE HALL

1 External

1.1 General

1.1.1 The one external facade of this building has been little modified. The windows, masonry and metalwork should be reconstructed.

1.2.1 The roof and monitor should be preserved.

2 Internal

2.1.1 General

One of the most important aspects of the Turbine Hall are its dimensions including the impressive height of the ceiling. The feeling of space in this hall should be preserved.
2.1.2 The walls should have all cables, conduits and insubstantial elements removed.

2.1.3 The remains of the steel joists which held the turbine floor should remain visible.

2.1.4 The wall tiles in the Turbine Hall should be preserved.

2.2.1 Access from the Turbine Hall to the Boiler House should be through existing doorways. If new penetrations are necessary, they should be so placed that existing penetrations are preserved.

2.2.2 All existing cast iron light brackets should be preserved. Missing brackets should be reconstructed.

5.0 OLD BOILER HOUSE - DC PUMP ROOM

1 Exterior

1.1 General

1.1.1 The remaining north and east facades and the remains of the first chimney should be preserved and missing elements of the facade should be reconstructed where possible.

1.1.2 The roof may be reconstructed to conform to the present configuration provided by the remaining truss.

2 Interior

2.1 General

2.1.1 The original floor level and original penetrations should be preserved.
2.1.2 The basement beneath the DC Pump Room should be preserved.

2.1.3 The tunnel which provides access to the original well should be preserved and access to the tunnel should be provided.

2.1.4 The outlines of the flues and the supporting arches in the brickwork between the DC Pump House and the Boiler House should remain visible.

6.0 NEW BOILER HOUSE

1.0 External

1.1 General

1.1.1 The three facades exhibit changes in their fabric which indicate changes in steam generating technology. It is these changes which are of significance to the complex and, as such, they should be preserved.

1.2 The East Facade

1.2.1 The east facade is divided into thirteen bays, two of which are combined to form an entrance. (For convenience, the bays will be numbered from left to right. The three tiers of windows will be termed ground, middle and upper).

1.2.2 Windows in bays 4 to 13 should be preserved or reconstructed using physical evidence. Where the physical evidence is missing reconstruction should follow the windows of the later period.

1.2.3 Bays 1 to 3
1.2.3 Bays 1 to 3
Masonry used to infill various windows which is unstable or of unacceptable workmanship should be removed. The resulting penetration should be infilled again.

1.2.4 Major elements such as the I beams which supported the ash handling plant platforms should be preserved.

1.2.5 Minor corroded accretions should be removed from the wall.

1.3 The Roof
1.3.1 The roof including the ventilation scoops and monitor should be reconstructed.

1.3.2 The chimneys should be extended to a point above the roof line.

1.3.3 Existing penetrations, through which the minor stacks emerged should be sealed in a way which acknowledges their existence.

1.3.4 Unstable relics on the roof may be removed.

1.3.5 If the parapet is to be reconstructed in sandstone, the present discontinuities which were formed to allow construction of ash handling plant or other structure should be allowed to remain. If another material (such as concrete) is used, the discontinuities should not be duplicated.

1.4 South Facade
1.4.1 The opening of the central doorway in this facade should have its margins sympathetically reconstructed.

1.4.2 All penetrations should remain visible.

1.4.3 Minor accretions may be removed from the wall but as much as possible should be retained for interpretative purposes.
1.4.4 Major elements and alterations should be allowed to remain.

1.5 North Facade

1.5.1 Any damaged elements reconstructed.

1.5.2 All present penetrations should remain.

2 Internal

2.1 General

2.1.1 All minor corroded or damaged accretions should be removed from the walls. The south end should be regarded as an interpretative area.

2.1.2 The walls, where bricks have been chipped away to allow installation of machinery, may be rendered if necessary to prevent accumulation of dust and further degradation. Old conduits and brackets may be removed.

2.2 The Southern end

2.2.1 The total of the structures south of the third pair of steel pillars (immediately to the north of the chimney bases) should be preserved. This includes the six pillars, the associated beams, the coal hopper, the dry coal hopper, fan floors and small elevator. Remnants of electric switches, lights and cable ways attached to the walls should be preserved where their condition permits.

2.3 The Northern end

2.3.1 The columns, beams and hoppers are significant remnants of the previous use of the Boiler Room, but more importantly, they provide a scale to the space itself and consideration should be given to their retention on aesthetic grounds. The fan
floors in this section may be cleared to allow the light-weight roof trusses to be seen.

2.3.2 Both relieving arches in the wall and remnants of the flues on both the east and west side of the south wall should remain visible.

7.0 SWITCH HOUSE

1 External

1.1 General

1.1.1 The whole facade including all concrete render, dentils, caps and parapet should be preserved or reconstructed.

1.2.1 The roller doors on the substations which line the south facade should be preserved.

1.2.2 The massive wooden doors on the south end of the last facade should be preserved or reconstructed.

2 Internal

2.1 General

2.1.1 The present configuration of rooms, entrances and penetrations should be preserved.

2.2 Concrete conduits

2.2.1 The concrete conduits for the electric cables which are level with the first floor's last facade windows and in the cable tunnel on the western side of the building, should be preserved.

2.3 Concrete Switch Cabinets

2.3.1 One complete set of concrete cabinets should be preserved on each floor.

No other building exemplifies the rate of increase in technology as much as the Switch House. This building was needed to cope with the distribution of the current which was formerly done by switchboards located in the Turbine Hall and Engine House. The Switch House has undergone little modification since it was completed in 1929.

The conduits are an integral part of the design of this building and are among its most important relics.

The concrete cabinets are an integral part of the design of the building and one set should be preserved. It may be possible that electrical apparatus from the cabinets could be found to add to the interpretation of the building.
2.4 Stairways
2.4.1 All stairways should be reconstructed.
2.4.2 All handrails should be reconstructed.

8.0 THE INTERPRETATIVE AREAS

The interior of the Power House will be changed substantially in order to accommodate the needs of the museum. In order that visitors be able to interpret the building as a whole, it is recommended that two areas be set aside and minimally disturbed. One such area is the engine room and the other is the southern end of the boiler house.

Suitable permanent graphic material should be displayed in these areas that detail the history of the Power House, buildings and the technology that it housed. It should also be possible to mount a short audio visual show that indicates the scale and type of machinery used in the generation of electricity.

The engine room may not be able to remain in its present configuration for structural reasons. However, every attempt should be made to retain it before major modifications are executed.

The boiler house southern end should present no such problems.

It is essential that the hoppers, fan floors, chimney, six columns, the small dry coal hopper and the personnel elevator be conserved. These are the only remaining artifacts in the boiler house and form a substantial part of the total surviving from the electricity generating period.

Suitable graphic material, appropriately sited, may be placed outside the buildings to illustrate various changes through which the Power House has gone.

The Public Works Department's architectural team have proposed that an interpretative two dimensional structure, which indicated the size and configuration of the pneumatic ash and coal handling units, be erected at the southern end of the boiler house. The proposal has a great deal to recommend it as it will provide information for interpreting the building and will facilitate the retention of certain portions of the fabric of the east wall of the boiler house.
9.0 ACQUISITION OF ELECTRIC GENERATING AND DISTRIBUTING EQUIPMENT

Until recently, New South Wales had a great deal of early electricity generating and distribution equipment. Much of it has been lost as both Government and the private sector change to a more advanced technology. It is imperative that a collection of the extant equipment be started immediately for the purpose of eventual display in the Power House Museum.

The collection should represent all periods of technology from the earliest to the present. In many cases the cost of redundant equipment would be negligible and in the case of White Bay assistance may be given to help dismantle and pack the artifacts.

The Sydney County Council, (Clarence Street Substation especially), the Broken Hill Proprietary of Newcastle and Vickers Cockatoo Island Dockyard all have pieces such as marble switchboards with knife switches and open air circuit breakers, motor generator sets, rotary converters and Hewittic mercury arc rectifiers.

Perhaps the richest source for redundant equipment is White Bay Power House. White Bay was the sister to Ultimo Power House and a collection made here would be most appropriate. The equipment extant at White Bay includes a motor generator set, a rotary balancer, a small marble switchboard, an accumulator set, oil bath circuit breakers, marble mounted rheostat sets and several control room panels.

Other power houses such as Bunnerong and Wallerawang may, in the not too distant future, have items of interest to the museum.
SECTION I

ARCHITECTURAL DESCRIPTION

1.0 THE ULTIMO POWER HOUSE COMPLEX

The Ultimo Power House consists of a complex of six buildings. Examination of the architecture reveals both strictly utilitarian and ornamental features on the facades of the extant buildings. Three of the buildings, or parts of them, date from 1899, two from 1902 to 1905, and one from 1929. A sketch plan of the complex is shown in Figure 1.1.

The Office Building (A), the Pump House which is part of the old Boiler House (B) and Engine Room (C) date from 1899. The Turbine Hall (D) was built in 1902 as an extension of the engine room. Between 1902 and 1905, the new Boiler House (E) was built partly on the site of the old boiler house and adjacent to the engine room. Increases in electrical generating technology and in the distribution of power resulted in the construction of the Switch House (F) in 1927.

Fig. 1.1 The Ultimo Power House - general layout.
2.0 THE OFFICE BUILDING

The office building serving the Ultimo Power House is a three storey symmetrical building, 30m wide and 14m deep, with seven bays, built in a simplified Italian Renaissance Classical style.

It faces William Henry Street and is now largely obscured because of the widening and raising of the road approaches as it faces William Henry Bridge. The rusticated stone base supports a stone plinth on which sits the brick superstructure. The articulation continues in the form of brick pilasters with a sandstone entablature, above which is a brick parapet. (Fig. 1.2)

Fig. 1.2 The office building is executed in brick and stone in a simplified Italian Renaissance style.
The roof of the engine room incorporates a louvred ventilating monitor with a vaulted corrugated iron roof. The monitor runs the length of the engine room only and was not built above the switchboard mezzanine. There were formerly ten prominent outlet vents fabricated from sheet steel (or iron) with deflecting, conical caps and finials. Two of these vents remain. (Fig. 1.6)
5.0 THE TURBINE HALL

The Turbine Hall is a very simple, very strong expression of the utilitarian architecture of the early 20th century and one of the prime large examples of Edwardian industrial architecture in Sydney. Its size 56m x 31m reflects the size of the engines it was designed to house. The facade is divided into eight bays which are further proportioned by a horizontal band which divides the facade into sixteen elements. The west facade's principal quality is sheer scale which is enhanced by very carefully controlled simplicity. (Fig. 1.7)

Fig. 1.7 The west facade of the turbine hall is divided into eight bays. The principal quality of this facade is its sheer scale.

Emphasising the main articulation of the facade is a moulded stone stringcourse at the sill level of the upper windows, and a moulded stone cornice capping the top of the parapet.
The main elements are the very tall semi-circular headed windows. These main windows have stone sills which were originally designed as an important part of the west façade but have been subsequently obscured by the conduit tunnel and retaining wall. The fine windowed bays, flanked by pilasters, terminate in stepped brick corbels and are surmounted by a stone gable cornice. The windows, some of which were altered to allow the abutment of the switch house, were tall and semi-circular headed to match the ones on the west façade.

6.0 THE SWITCH HOUSE

The switch house is a brick building, three stories high. However, from the west, the façade's two stories are above ground level, the east façade contains the full three stories. The switchboard is 17m high x 23m wide and 61m long.

The switch house encompasses general architectural features which are beyond utilitarian design. The west façade is divided into seven bays, the northernmost of which is given emphasis by means of a dentillated gable which incorporates a centrally placed circular motif with herringbone infill. The remainder of the building features a dentillated segmented extension of the parapet. The brickwork between each pair of windows extends even higher and terminates in dentillated bracketed caps. All dressings, sills, lintels and caps are of rendered concrete. (Fig. 1.8)

The west façade is a forceful architectural statement in the incipient art deco style, unusual in industrial buildings. The impact of the eastern façade is emphasised by the lower viewing area and the greater height of the façade; here it is the full three stories. The switch house consists of upper and lower sections. (Fig. 1.9)

The upper section is three stories high and occupies the west and south end of the east façade, approximately half of the width of the building. This section is L-shaped. This taller section, which is similar in style to the west façade, includes a series of recessed panels, some of which contain windows, others decorative brickwork colour in stacked header bond, herringboning, and standard coursework. The ground floor of the two south bays consist of rendered concrete construction, with recessed panels, some of which incorporate windows.

Fig. 1.8 (opposite). The west façade of the switch house with its dentillated gable and dentillated segmented extensions of the parapet.
The lower section is one storey high and occupies the remaining four-fifths of the east side. It is given a very strong and simple architectural treatment and contains eight openings with massive roller shutters behind which the transformers were installed.

Fig. 1.9 The east facade of the switch house has a three storey section and a single storey section. The roller-shutter doors are on the transformer bays.

7.0 THE NEW BOILER HOUSE

The new boiler house is the largest building in the complex, it is 83m long and 23m wide.

It has the largest continuous facade to the east. The original design of the building reflects the two-tiered boiler arrangement used in the old boiler house and the architecture is largely
utilitarian. The three tiers of windows, arranged in thirteen bays, are a vigorous architectural solution to the problem of dealing with a very tall facade. The height from string course, to plinth is much greater than on the west facade of the turbine hall, which it complements. (Fig. 1.10)

Fig. 1.10 The new boiler house shortly after the completion of the northern section in 1905. This facade, especially the southern end, has been altered during successive changes in technology.

The thirteen bays are evident on the top tier of the building, above the string course. Below that, the fourth and fifth bays from the north end were combined to form a tripartite entrance bay, which allowed access to rail trucks on the east siding.

The south facade of the boiler house, although abutting the turbine hall and matching it in size, was treated somewhat differently, preserving the individuality of the building. The pilasters, their terminations in stepped corbels, and the gable cornices, are the same, but the windows are smaller, arranged
in two tiers, and segmental-headed as on the east facade. (Fig. 1.11)

Fig.1.11 The Southern facade of the boiler house with its enlarged windows. This photograph was taken after work had commenced on the reuse of the building.

8.0 SUMMARY

Individually, all the buildings in the Ultimo Power House complex have both quality and scale which merit consideration on architectural grounds. Collectively they are unique, for they express the growth of the electrical power industry from the late nineteenth century to the mid-twentieth century. All four facades are architecturally and technologically interesting but the west facade, which incorporates elements from 1899 to 1929, is outstanding. The bricks, the mortar between them, the careful detailing of the other materials, the technology the structures house, the powerful architectural treatment, varies from the office building to the switch house, and the whole is a graphic example of industrial architectural history - the best of its type in Sydney.
I

9.0 CONDITION OF THE BUILDINGS IN 1982

INTRODUCTION

By 1982 the once proud complex, previously one of the most advanced technological Units in the world, and one of the great landmarks of Sydney with its three chimneys all in excess of two hundred feet, was reduced to a badly vandalised brick shell. (Fig. 1.12) Almost every piece of machinery, switchgear, electrical gear and apparatus had been removed for salvage or reuse. The chimneys had been demolished to below the roof level. Almost every pane of glass had been smashed. The roof in the turbine hall and the boiler hall had been damaged by incompetent chimney demolition. The large coal and ash handling units had been removed and scrapped. Stairways, railings, cables had been removed and fires were started by squatters or vandals in all buildings.

Besides the active vandalism no attempt had been made to maintain the buildings as evidenced by the growth of plants on the engine room. The roof over the office building, engine house and old pump room deteriorated and much damage was caused by rainwater.

However, structurally the buildings survived well. The walls and roof trusses are still sound - a tribute to the early designers and builders.

Some spalling of the reinforced concrete in the caps on the switch house has taken place and there is some degrade of the sandstone capping, but no irreparable damage has been done by man or elements.

OFFICE BUILDING

Most of the cedar doors, the spiral staircase, the front doors and the lead from the stained glass window have been removed. Many of the windows on the ground floor have been broken. Internal partitions on the ground floor and first floor have been broken by vandals or demolishers. Almost every porcelain toilet fitting has been smashed. (Fig. 1.13)

The roof has deteriorated severely in several places and water entering from these openings and the broken windows has damaged the hardwood office flooring. Numerous fires have been started by squatters in the rooms on the western end of the ground floor.

Fig. 1.12 (opposite). The Ultimo Power House in 1982 before work had commenced. The Southern or left hand end of the boiler house shows the changes to the fabric caused by the installation of the various ash handling plants.
The ground and first floors are covered in building debris, timber, ceramic toilet ware, terracotta brick, old newspapers and sundry pieces of delapidated furniture. The floor of the basement is in a similar condition although there are traces of an electrical workshop in the form of broken benches and spare used parts.

Fig. 1.13 The interior of the office building. This building was the most ornate in the complex. Its association with the generation plant is shown by the tiled floor and the tiled walls which were contiguous with those in the switch gallery of the engine room. The office walls, floors, and fittings have been badly damaged by vandals.
THE OLD PUMP HOUSE

The north east corner of the pump house and the chimney were demolished to make way for the expansion of the iron bridge in 1963. The corrugated iron roof which remained over the western half of the building is in very poor condition. No roof remains over the eastern side and the Sydney Council has allowed the area to be used as a dump for exhausted hot mix and other debris. This accumulated debris, combined with rainwater damage had led to the collapse of this section of the floor of the old pump house. (Fig. 1.14)

Fig. 1.14 The old pump house. This was formerly an integral part of the old boiler house.
THE ENGINE ROOM

All the generating equipment, switchgear and substation equipment was removed years ago. Many of the cast iron gratings which formed the floor in some sections and allowed crane access to the basement has been taken for scrap. The electrical motors on the cranes, and even the bronze axle bearings of the cranes have been stripped. The marble and slate switchboards have been broken except for some sixteen panels on the direct current gallery and nine panels on the substation in the centre of the room. (Fig. 1.15)

Fig. 1.15 The DC switchboard gallery in the engine room. The remaining marble panels are on the left. The continuous plate girder crane beam is on the right. The cedar hand rails and some posts have been vandalised. The floor has been stripped of tiles.

All electrical gear on the western gallery has been taken, even the brass covers and toggles from the electric light switches have been salvaged.
But the salvage was not done with precision. Engines were smashed from their beds, slate panels broken to retrieve the last remaining pieces of copper, balustrades and railings torn out to allow easy access for demolition equipment.

The original floor level, with engine beds for the small turbines and the air compressors which protrude above this level, as well as the cast iron beds for the five rotary alternators, remain. So do both galleries and most of the steel railing and stairways but the terracotta tile floor has been very badly damaged during an aborted salvage operation. (Fig. 1.16) Wall tiles are similarly damaged. The 1899 cokebreeze engine beds which were laid for the Allis-General Electric engine generator sets are still in-situ, though somewhat modified. All other evidence surviving from 1899 on the basement has been removed.

Wind damage to the roof and guttering has allowed rainwater to run onto the matchboard ceiling which has promoted rot. This water then ran onto the reinforced concrete floor and caused various elements to rust. The basement area of the engine house was very damp and is littered with boards and rusting debris.

Fig. 1.16 The switch gallery on the western wall of the engine room. The rail has been removed and all the equipment salvaged. The wall tiles date from 1902.
THE TURBINE HALL

All the equipment including all turbo alternators was removed shortly after the closure of the plant in 1963. All that remained was the floor, still at its 1902 height, the railings that surrounded all access ways, the southern gallery which gave access to the switch house and the huge concrete machine beds with their cast iron caps. The machine beds, when viewed from the ground level appeared to be massive and to dominate a significant portion of the interior of the hall. (Fig. 1.17) However when viewed from the new control room in the switch house they appeared much less significant. (Fig. 1.18)

Fig. 1.17 The massive concrete bed for No 3 turbine as seen from the basement.

Fig. 1.18 (opposite) The turbine hall in December 1982, looking north west, before demolition of the engine beds and walkways was commenced.
The ground floor and turbine floor were covered in rubble and broken glass and the basement floor had in excess of 600mm depth of debris in parts.

An unsuccessful attempt had been made to remove a great number of the terracotta floor tiles and many of the broken tiles remain where they have been wrenched from the floor. (Fig. 1.19) Certain sections of the porcelain wall tiles have been similarly damaged.

Fig. 1.19 The turbine hall looking south west. before demolition began in 1982. An attempt had been made to salvage the terracotta floor tiles, and the hand rails have been removed.

It should be noted that very little, or perhaps none, of the original 1902 floor survived in the turbine hall. It had been renewed and altered along with the engine beds in successive upgrading of generating equipment. The tile wall was in the main original though some sections had been repaired over time and other sections had suffered by having accretions anchored to them in the later phases of power generation.
The boiler house, with its very high roof and the rivetted and welded steel columns, coal hoppers and massive chimney bases give a scale to the very large space which was almost cathedral like. (Fig. 1.20) The long windows on the eastern facade add to this feeling. However in reality the boiler house was never a large relatively clear space. It was always incredibly cluttered with boilers, coal hoppers, stokers, fans, pipes, chutes, gauges, valves and stop cocks. But in 1982 it was the most impressive and emotionally evocative of all the structures. (Fig. 1.21)

Fig. 1.21 The boiler house coal hoppers. These massive hoppers fed coal to the basement floor where it was pulverised prior to being blown into the boilers.

Fig. 1.20 (opposite) The boiler house. The chimneys, hoppers and steel columns add significantly to the cathedral like space of the building.
The grinding floor or basement has been used as a dump for pipes, tyres, and motor parts and other debris and seepage from the land above has filled it with some 1.4m of water. (Fig. 1.22) The stoking or ground floor, still has several large holes in which the boilers have been embedded and the large girders which held the floor were clearly visible. This floor had been damaged by the felling of the chimneys in 1973 and much of the rubble from the chimneys was still in the basement.

![Fig. 1.22 The boiler house basement. The elevation which was erected abutting the western chimney can be seen on the left. The basement was stripped of its machinery and then used as a dump for waste material.](image)

The walls however were still very much intact and showed surprisingly little damage considering the amount of machinery and material that had been removed.
THE SWITCH HOUSE

The switch house, being the newest of all buildings in the complex has suffered perhaps the least amount of damage. All equipment was removed from it and only the concrete cabinets which supported the switch gear remain. (Fig. 1.23) However, the doors to these cabinets litter the floors throughout, as does broken glass from the internal windows.

Fig. 1.23 The switch house. The cabinets and conduits which carried the bus bars and cables were made from moulded concrete. Almost every single piece of electrical equipment had been removed from the switch house and almost every pane of glass, both in internal and external windows, had been smashed.
All handrails were originally of brass and have been cut from the forged mild steel posts and many of the steel window opening mechanisms have been removed for scrap. (Fig. 1.24)
The reinforced concrete conduits which run along both the east and west side of the three storey section of building and which carried the electric cables, are in poor condition through spalling, especially where they have been open to the elements. (Fig. 1.25)

Fig. 1.25  The switch house. The reinforced concrete conduits have been damaged by salvage operations, and by vandals. Most acute damage has been caused by rusting of the steel reinforcing which expands and blows the concrete off.
SECTION 2.

THE BUILDING OF ULTIMO POWER HOUSE

1.0 BACKGROUND

One of the most significant facts about the construction of the Ultimo Power House is that it was not conceived as a single independent entity, but was planned and designed as part of the first extensive electric tramway system in Australia. The construction of the Ultimo Power House is inextricably bound up with the building of the George Street and Harris Street electric tramway. Of the thirty-four contracts for the tramway listed in the Annual Reports of the Department of Public Works for New South Wales, only half are for the construction of the Power House. (See Table in appendix).

The original plan had been to extend the Rushcutters Bay Power House at the Ocean Street cable tramway in order to supply power to the George Street line. It was estimated that the new tramway would require 540hp., and that the addition of three generators of 300 hp., each to the existing plant at Rushcutters Bay would provide sufficient power. The current would have been carried to the new tramway by overhead cables supported on poles.

With the abandonment of this plan and the decision to convert the whole tramway network to electric traction, it was necessary to construct a central power house. The Railway Commissioners were ultimately responsible for the accurate forecasting of the power requirements for this conversion. But, the designers of the Ultimo Power House can hardly be held responsible for the inadequate forecast of power requirements.

Detailed research would be necessary to ascertain how the Railway Commissioners arrived at their estimates but with our historical perspective it is evident that their forecasts were very low. It was during the late nineteenth and early twentieth century that the great advances in steam turbines were made, allowing vastly increased capacity although still requiring a relatively small area of floor space. Indeed the steam turbine effectively replaced the reciprocating steam engine as an economic source of motive power by 1910. Had these advances not been made, then by 1909 the Ultimo Power House would have had no room for the installation of more generating plant, and would have been inadequate after only 10 years of service. As it was, this stage was reached by 1913, after 14 years of service. Although Ultimo remained in service until 1963, essential replacement occurred by 1913.
2.0 ELECTRIC TRACTION

.1 INTRODUCTION

During a visit to the U.S.A., the Chief Mechanical Engineer for the N.S.W. Railways examined the various methods of street traction and on his return recommended that electric traction be introduced to Sydney. As a result, an experimental and also the first electrified tram service commenced operation in 1890 on the Randwick-Waverley extension of just over 2km (1.3 miles). However, continuing technical problems saw to its demise after 17 months. Isolated electric lines which operated successfully in North Sydney and Rushcutters Bay were opened in 1893 and 1898 respectively.

The rapid growth in existing steam tram patronage led to a strong public demand for improved transport conditions. A further trip to England in 1895 by the Chief Commissioner for Railways and the department's electrical engineer, who also visited the U.S.A. on the way home, was to see the production of a report to the government strongly favouring the overhead electric system and recommending its installation.

Indirectly, the choice of electric over cable traction was not clearcut. In 1890 there were 930km (600 miles) of cable way and 1,085km (700 miles) of electric tramway in the U.S.A. However six years later, in the same country, there were only 855km (532 miles) of cable way and 16,060kms (10,363 miles) of electric tramway. Arguments still raged over the relative merits of cable and electric traction, and initially Sydney, flirted with both systems.

.2 GEORGE STREET AND HARRIS STREET ELECTRIC TRAMWAY ACT 1896.

On one previous occasion the Parliamentary Standing Committee on Public Works, N.S.W., had been commissioned to report on the expediency of a cable tramway on the George Street and Harris Street line, the report being presented in Parliament in 1891. A recommendation was given not to proceed with the tramway until the construction of the King Street to Ocean Street cable tramway had been completed and its profitability established. Furthermore, little discussion was included in the report of the relative advantages of cable and electric tramways possibly as this was fully considered by the Committee reporting in the same year on the King Street to Ocean Street tramway.

The idea of an electric tramway was shelved until 1895. By this time substantial advances in electric traction had been made in both Europe and the United States. The Parliamentary Standing
Committee for Public Works, N.S.W., was thus able to recommend in 1896 that the George Street and Harris Street Electric Tramway be constructed, but the electric power be provided from the Rushcutters Bay Power House which powered the successful King Street to Ocean Street cable line.

Thus from the outset, the provision of electric power was considered as part of tramway construction. The George Street and Harris Street Electric Tramway Act was given assent on 6 September 1896. An estimated £130,500 sterling was set aside for construction. Of this amount, it was estimated that the extension of the Rushcutters Bay Power House and feeder cables would cost £17,150.

Then, on 22 November, by a further Act of Parliament the Railway Commissioner who had responsibility for operation of both railways and tramways was allocated £150,000 sterling for the conversion of all tramways to electric traction.

However, almost immediately the George Street and Harris Street Electric Tramway Act had been passed, the Railway Commissioner began to discuss the advantages of constructing a central power house for the whole tramway system. The attempt was made to refer these plans back to the New South Wales Government for more funding since this would have involved another inquiry by the Standing Committee for Public Works and more delays. The Standing Committee, by law, had to report on any public works requiring funding in excess of £20,000 sterling, however the Railway Commissioners were not so legally bound. The decision was then made to finance the cost of building a central power house through the Department of Railways utilising the £150,000 which had been received for electric conversion. Only in this way could construction proceed without delay, and it is for this reason that the Ultimo Power House remained as a major part of the works for the George Street and Harris Street electric tramway.

Further consideration was given to the location of this central Power House at Rushcutters Bay in view of the capital already invested there. However, a site in Ultimo was eventually chosen because of its various advantages.

THE FIRST STEP: 1897

Once the decision had been made, resumptions of land for tramway purposes proceeded rapidly. These were notified in the Gazette in March and closed in April 1897. The first formal statement concerning Ultimo in Government Reports is H. Deane's report in the year ending 30th June 1897, where he stated:
"land has been resumed between Mary-Ann Street and William Henry Street, Ultimo, for the erection of the power house and car house required for not only the George Street and Harris Street Tramway, but also for the conversion of the whole existing system."

According to Deane's sketch plans, the arrangements of the power house and offices were "well-advanced by 30th June 1897, and a contract (1612) was already under consideration."

LOCATION OF THE ULTIMO POWER HOUSE

Several important factors required consideration in the location of a central power house and these may be listed as follows:

1. distribution of electric current,
2. coal supply and disposal of ashes,
3. water supply,
4. space for future extension,
5. cost of land,
6. character of foundations and
7. availability of labour force.

Deane and the Railway Commissioners, especially the Chief Commissioner Mr. Eddy, were responsible for the eventual choice of Ultimo for the central power house for the whole tramway network. It was considered important that the power house should be located at the centre of the network, since direct current (DC) could only be economically transmitted over short distances. When the purchase of the land at Ultimo was being considered in 1896, it was intended at first to buy the whole city block bounded by William Henry, Harris, Macarthur and Pyrmont Streets, the latter in those days being adjacent to the Darling Harbour Railway Goods Yards. Both the power house and the car house were to be constructed on this block. However, eventually it was decided in the interests of economy to resume only 4½ acres of land which lay between William Henry and Mary-Ann Streets, running parallel to Harris Street and Darling Harbour railway line for nearly 600 yards, and some 50 yards from the alignment of Harris Street. In this way the more expensive Harris Street frontage was avoided, but this saving appears to have been partly offset by the unforeseen extra costs incurred for foundations.

The location of the Ultimo Power House had some definite advantages. Being near the head of Darling Harbour there was an adequate supply of salt water for condensers. The proximity of Darling Harbour Railway Goods Yards would facilitate both coal supply and ash disposal.

Furthermore, Ultimo was in the centre of the whole tramway network.
and since it was considered important that services should be kept together, both the power house and the car house could be located on adjacent city blocks.

Ultimo also had the space required for projected future expansion, since it was envisaged that the power house would eventually have a capacity of 20,000hp.

It appears that soil stability was not adequately considered when the choice of the site was made and soil tests were probably not undertaken. Not until provisional design and planning work was completed was it realised that substantial concrete piers would be required for the car house footings. In addition many extra costs were incurred for the power house footings. Concrete settings for the plant had to be sunk fourteen feet, that is twelve feet in excess of the original specification. Furthermore, at least 1,000 cubic yards of additional excavation had to be completed for wall footings.

3.0 BRIEF HISTORY OF THE ULTIMO POWER HOUSE SITE

The land now occupied by the Ultimo Power House and the Sydney Tramways Depot once formed part of the Ultimo Estate. On 1 July 1806, Governor King granted 135 acres to Surgeon John Harris in the District of Sydney. The grant stretched from Cockle Bay to Black Wattle Swamp Bay and up to George Street, in the region known today as Railway Square. The Surgeon died childless on 27 April 1838, leaving his Estate to his two brothers George and William. They could collect rent from the property but were not given permission to subdivide. Partition of the land could only occur on their deaths when it was to be equally divided between their sons, John Harris of Ultimo and John Harris of Shane's Park.

The partition of the Estate took place in July 1859, three years after the death of William Harris. By this time John Harris of Ultimo had also died, leaving a wife and six children, all of whom received equal portions of his share of the land. It was from this subdivision of the Ultimo Estate that the present pattern of streets was established.

The sites under investigation formed Blocks 23 and 20 (Fig. 2.1) of the subdivision; Block 23 was inherited by Margaret Harris, at present it is not known who inherited Block 20.

In October 1898 Margaret Harris sold the eastern portion of Block 23 to the Department of Public Works for £7,727.12s.11d. This portion became the site of the Ultimo Power Station.

Fig. 2.1 Early map showing the subdivision of Ultimo. Lots 21, 22 and 23 became part of Darling Harbour Goods Yard. Parts of Lot 20 and 21 were purchased for the Ultimo Power House.
Margaret Harris later sold the corner site of William Henry and Harris Streets, the site of the present Post Office, to the Postmaster General. The Post Office was erected in 1901.

In December 1901 Margaret Harris leased 1 acre and 13½ perches at 496 to 550 Harris Street to the Sydney Glass Co. Ltd. The company finally bought the site for £10,000 in September 1922.

The plan submitted for torrens title shows a building adjacent to the Post Office, where the Dalton stood prior to demolition in 1983, and some galvanised iron sheds. The Dalton building, the second permanent building on the site was constructed in 1960.

In April 1948 the commissioner of railways purchased no 550 Harris street (26 3/4 perches), thus giving a footage to the street. (Fig. 2.2)

Fig. 2.2 Plan showing Block 23 at the time of its resumption by P.W.D.
The Sydney Glass Company sold the land in January 1954 to Herman Haegé Ltd. The land was then leased out to another company who then leased a portion of the block to Ampol Ltd. in December 1957. The Ampol Service Station was probably constructed shortly after this. The total block was resumed by the Minister for Public Works in January 1981.

The corner block of Harris and Macarthur streets was first purchased from Margaret Harris by Maurice Newstead in July 1923 for £3,750. He mortgaged this land to the E.S. & A. Bank and on his death in 1938 the land became the property of the Bank. They sold the land to Maize Products Pty. Ltd. which built the existing building in 1938. The land was resumed by the Minister for Public Works in August 1980.

As stated previously it is not known which Harris heir inherited Block 20, the site of the Tramways Depot. However, it is known that the Tramways Authority resumed that portion of the block in November 1911. Further research could reveal who owned this land prior to its resumption.
SUMMARY OF THE HISTORY OF ULTIMO POWER HOUSE

Major changes and events at Ultimo are timetabled below to provide an easy index to the architectural and technological details outlined in later sections.

1895 Sept 18 - Minister for Public Works asked for necessary information to refer proposal to construct an electric tramway to Public Works Committee (P.W.D.).

Dec 6 - Railway Commissioners submitted their report to P.W.D.

1896 May 8 - Public Works Committee voted 6 to 5 in favour of electric tramway.

Sept 6 - "George Street and Harris Street Electric Tramway Act" assented to: 60 Vic. No 10.

Oct - Act passed giving Commissioners necessary construction/authority to introduce electric traction to existing and future tramways.

Nov 16 - Parliament voted £150,000 towards costs of conversion of tramway from cable to electric traction.

1898 June - Contract no 20, for the excavation of the Power House site, had been completed by C. McClure. By this date, most tenders for building the various sections of the Ultimo complex had been accepted. Messrs. J. Stewart and Company had been accepted to erect both the Power House and the car house. (Contracts 12 and 14 respectively). Messrs. Phippard Bros. had already made good progress on the chimney by this date.

1899 Nov 22 - First electricity supplied to George and Harris Street Tramway and a tram car made an experimental trip on the line.

Nov 27 - Members of State Parliament rode on the tramcars of George and Harris Street.

Nov 29 - The Ultimo Power House completed and opened for official inspection on 29 and 30 November 1899.
1899 Dec 8 - The George Street and Harris Street line officially opened for business. Power supplied for tramway traction by Ultimo Power House.

1900 - Supply of electricity extended to Eveleigh Railway Workshop.

1901 Sept 12 - The first serious breakdown. Shortly before 9pm flames broke out in the vicinity of the switchboard. The insulation for the large distributing cables had actually been burned off and power was completely cut off. Surprisingly quick action by both administrative and electrical branches resulted in a shut down time of less than 24 hours.

1902 - The extension of plant:
Twenty-four Babcock and Wilcox water tube boilers, working at 1601b. pressure and 250 AP each, were installed.

Two new chimney stacks were built side by side in the southern extension of the boiler house. When completed, they towered 224ft. (65m) above ground. Each was capped with a cast iron crown.

The engine room was extended by another 45m making it the same length as the boiler house.

Three of the planned six huge 450 tonne Allis cross compound reciprocating steam engines, coupled directly to the General Electric Company alternators were installed.

The North Shore, Dulwich Hill, Leichhardt and Glebe Point lines were converted to electricity and then Pitt Street and Castlereagh Street lines were opened.

1905 - King and Ocean Street lines were converted 15 January 1905.

Abbottsford converted to electricity 16 April and La Perouse and Little Bay converted on 19 June. Finally, on 17 October, "the sole remaining portion not worked electrically was converted". (N.S.W. Railway Budget, October 1, 1907).

- Completion of the building stage two of the boiler house.
1907 - Ultimo also added to its list of receivers, the newly built Railway station at Central in Sydney, which was equipped as a Tramway traction substation with 3 x 450kW converter units and associated switchboard apparatus.

1908 - Ultimo Car Shed extended 150 feet. Ultimo boiler house plant - Superheaters fitted to 28 out of the 48 Babcock and Wilcox boilers.

1909 - Engine house plant - Marked the advent of the disc and drum type of turbine: Ultimo ordered 3 x 6,600 volt, 750 r.p.m., 5,000 kW turbo alternators. The alternators, manufactured by Messrs. Dick Kerr & Co., and the turbines by Wills & Robinson, were placed in service towards the end of 1911.

April 8 - Two new feeder panels erected on the AC switchboard and current supplied to new substation at Balmain.

1911 - A second switchboard gallery mounted above the existing high-tension switchboard gallery.

1912 - Ash handling unit - Installation of new pneumatic ash exhauster system meant handling of ashes by the staff was greatly reduced.

Boiler house plant - 8 of the original water-tube boilers were replaced by boilers of a larger capacity and more modern design.

White Bay Power Station commenced operation - this would eventually supersede Ultimo.

1913 - Tramway Instruction Room - Built as a fairly large single storey building with an asbestos shingle roof, located to the west of the office building and facing William Henry Street. Its purpose was to act as an instruction room for trainee electric tram drivers as well as a storage area for parts of tram car equipment (converted in 1954 to a store for the Electricity Commission of NSW).

1914 - 1917 - No further development took place in main generating plant: space originally available for such plant was now fully occupied. Since outbreak of war in 1914 very little extension of the tramway
system took place and so Ultimo's output was almost constant. On January 1st, 1917 the Government Railways (Amendment) Act of 1916 came into force, transferring all surveying and construction of the Government Railways and Tramways within the State from P.W.D. to the Commissioners.

1922 - Construction commenced in 1922 of the new Switch House which was to accommodate all the new high tension switch gear necessary to accommodate new generating equipment.

Decrease in supply to City Council, who now have their own additional plant installed in their own power house.

1924 - Chief Electrical Engineer, NSW Government Railways, Mr. Brain, interviewed re status of Ultimo - By this time, Ultimo was already more expensive to run than the recently constructed White Bay, which was now supplying almost 75% of the total electrical supply. Ultimo's plant was smaller and of an older design, even by this stage, and not as efficient as it could have been. For example no economisers had been installed at Ultimo. The site at Ultimo could sustain only a little more expansion, and this simply was not going to be adequate for the highly sophisticated, modern power houses that were projected for the future.

However, Ultimo was still useful (and too expensive to discard), so further improvements were suggested and carried out in the next few years to try and make it a more viable unit.

1926 - New Switch House completed (put into actual service 1928).

Completion of inlet tunnel to take circulating water supply from Darling Harbour to Ultimo.

1928 - Screening chambers for the new circulating water conduits completed and now in service.

1930 - Reduction in output due to the agreement to cancel supply of energy to Sydney Municipal Council. (Agreement took effect on 30 September 1929).
Turbine house plant - A 60 ton crane erected in the turbine house.

New 10,000 tonne coal storage bin built on the east side of the switch house. This would enable Ultimo to continue operating in the event of temporary stoppage of coal supply.

1931
- New coal handling plant introduced, coal now unloaded from trucks and elevated by means of a pneumatic plant, and distributed by belt conveyors.

1932
- Work of re-equipping Ultimo with modern boilers and turbo-alternators completed: boilers now burn pulverised coal.

Flood in boiler house basement and breakdown of energy generation. 15" water main burst and coal-pulverising and ash-handling equipment submerged to a depth of 9 feet. Ultimo didn't resume normal running until the evening of the following day.

1933
- Vacuum system installed for cleaning boiler house. New battery room erected.

1941
- Two additional single drum boilers with chain stoke grates installed in boiler house. These were among the last major items installed at Ultimo.

1947
- To cope with the effect war had had on coal supplies, Ultimo installed equipment which would allow 2 chain grate boilers and 4 pulverised fuel boilers to burn fuel oil.

1948
- The last two 5,000kW turbo-alternators numbers 5 and 8, now obsolete, were removed together with their foundations.

1949
- Transfer of 1 x 25 cycle, 18,750kW turbo-alternator from White Bay to Ultimo - to replace loss of above. Gangways and railing for it not transferred.

1950
- Electricity Commission Act passed - Ultimo Power House now under the authority of the Electricity Commission of NSW Act, effective 1st January 1953.

1952
- Foundations laid between the transformer for the 25 cycle 15,000kVA tie cable and the 15,000kVA transformer at White Bay Power Station.
1953 - Separator and most of the ductwork for flue dust extraction plant for No 1A boiler delivered.

1958 - One of the retaining bands on the first chimney stack of 1898/9 fell off (chimney originally taken out of service circa 1929/31).

1959 March 4 - Tender let for Demolition of the first chimney stack.
"Demolition to be performed brick by brick. Felling or demolition by explosive charge will not be permitted. Bricks to be dropped inside chimney to prevent damage to surrounding structures".

Sept - New quotations called for, as the original contractor made no attempt to carry out the demolition work.

Oct - New tender let to Johnmann Construction Pty. Ltd. for £3,405/5/0.


April 11 - Demolition completed. Only 25 feet of the base of the chimney now remain.

May - From this time, Ultimo shut down for the whole day Sunday, and for 4 hours Monday-Saturday.

1963 October 11 - Ultimo finally shut down completely. Although there is not much documentation of the event, the last existing staff of Ultimo Power Station organised a large party to celebrate the closure. (Personal communication, E. Crawford). The party was held in the Power Station itself, and some of the men climbed the roofs and stacks to hoist up a paying off pennant from the tops of the chimneys.

November 6 - Electricity Commission gave permission to remove the generating plant at Ultimo Power House, but allowed it to remain as it was for emergencies until 1964. As Vales Point Power Station increased its electricity supply from this date onwards, Ultimo was no longer necessary - even in the case of an emergency.

1965 March 23 - Tender accepted to demolish and remove Ultimo's equipment from Albert G. Sims Ltd., Mascot for £72,350/0/0.
Apl - Demolition begun.

1966 Sept - Demolition and removal of Ultimo's equipment completed.

1975 Sept - Decision taken to demolish the remaining 2 chimney stacks which, in a state of disrepair, with their retaining bands corroding, were a safety hazard. Decision also taken to lease or sell Ultimo Power House.

1976 Feb 23 - Tender for: "Demolition to ground level of the 2 brick chimney stacks of the disused and empty Ultimo Power Station, corner of Harris and William Henry Streets, Ultimo. By ground level is meant the main power house floor level which has direct access to power house roadways at ground level outside the building". Accepted from Tony Carr Pty. Ltd., it was supposed to be finished within 12 weeks.

Interest expressed in utilising the Power House by the Department of Technical Education and the Plumbing Institute of NSW. Neither, however, carried through their proposals.

1977 Aug - The 2 chimney stacks were demolished to just below roof level and their bases filled with rubble.

1978 Aug 23 - N.S.W. Government reserved Ultimo Power House and Tram Depot sides as a site for the Museum of Applied Arts and Sciences. A feasibility study for conversion of the sites to a museum was also announced.

1980 May - Contracts for Stage I of the Power House Museum announced; $4.7m allocated for refurbishing Ultimo Tram Depot.

Building Stage I Power House Museum

1981 - Stage I opened.

1983 Apl - Plans of Stage II of the Power House Museum were announced. $23m allocated to extensions and renovations of the Turbine House, Boiler House and Switch House.
FIG. 3.3. The engine room June 1899. The lattice columns, roof trusses and most of the roof is completed. By this stage the engine beds had been cast and were awaiting the installation of the Allis-GEC engine generator sets. The south end of the walls of the engine room remain dog toothed ready for the already envisaged extension of the power house.
FIG. 3.4 The first stage of the 1902 extensions. The engine room extension (later to be called the turbine hall) has been completed as has the southern half of the boiler house. The north wall of the boiler house extension, to the line of the old boiler house roof, has not yet been enclosed. In 1905 the new boiler house was to be extended to equal the length of the turbine hall and engine room combined.
FIG. 4.3: The engine generator sets 1 and 3 under test. Installation is incomplete with lagging, covering and floor to be finished.
FIG. 4.4: The Engine House Ultimo 1899. The four, two cylinder, cross compound steam engines are directly coupled to the DC generators which are adjacent the massive cast iron fly wheels. The rectangular boxed high and low pressure cylinders are visible close to the centre columns. Against the end wall is the DC switchboard gallery.

These engines used Reynolds-Corliss steam trip or control gear. T.H. Corliss, an American, devised his earliest control gear system in 1849 and he and others, such as Reynolds, provided many variations on it over the years. This gear maintained its popularity and was almost universal on this type of engine.

In his system, the exhaust valves were opened and closed by a reciprocating rod which took its motion from an eccentric on the engine shaft, acted on a crank which oscillated and operated rotary valves by reciprocating rods. The separately operated rotary

In his system, the exhaust valves were opened and closed by a reciprocating rod. The rod took its motion from an eccentric on the engine shaft, and acted on a crank which oscillated and operated rotary valves by means of reciprocating rods. The
FIG. 4.5: This view of the original DC switchboard on the gallery at the northern end of the engine hall shows the 10 distributor panels in the background. The gallery is still in existence.
FIG. 4.6: With construction still incomplete the boiler detail is clearly visible showing the multi-tubular construction. Firing was external and underneath the boiler cylinder. The hot combustion gases were ducted to the back of the boiler and through the tubes thence up to the main flue gallery. The steam header for that bank of boilers is installed above them.
FIG. 4.7: The front face of six of the western bank of boilers in 1889. Ornate cast-steel work made up the face. The top doors were for access to the boiler tubes for cleaning, the next set for hand firing and the bottom set of doors at floor level for ash disposal. Hand firing from the small wagons is underway. The overhead steam pipe is from the eastern bank of boilers.
at constant speed, apparently without effort. On each end of the shaft, the engine crank, in a blur of flashing light from the afternoon sun, converted reciprocating force to rotary motion, one crank driven by the high pressure cylinder, the other by the low pressure cylinder. The cylinders were somewhat disguised in their rectangular boxes with the extended piston rod covers on the outside and the rod slide guides or crossheads on the crankshaft side. Engineers from these days were still part artist and the use of left and right-hand engines provided an order in the machinery layout and, more usefully, symmetry of the engine foundation and steam piping under the floor. 27.

FIG. 4.8: Ultimo Power House 1899. Diagrammatic layout of the machinery.
FIG. 4.9: One of the Allis/General Electric alternaters during erection in the engine hall, extension (turbine hall). The massive spoked flywheel, shrouded by the stationary armature, is clearly visible between the cylinders. The high pressure cylinder is at the back with its steam main curving gracefully to its connecting joint behind the governor. On the near side is the enormous low pressure cylinder and the exhaust steam duct leading to the underfloor condenser. The exciter slip rings are visible on the shaft at the base of the spokes.